Job Skill Training

1980

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Executive Summary

The recent creation of the Department of Education by Jimmy Carter provides a unique opportunity for our firm to evaluate, restructure and expand our current Lalonde job skills training. **The program as evaluated in 1978 proved overall successful, especially among those with a high school degree, and it is safe to focus on named subgroup. However, due to lack of confidence in the models, it is recommended to revisit the model's performance.** It remains unclear what factors contributed most strongly to the success since the performance of the models tested poorly, and a more thorough analysis is highly recommended. The inspection of correlated factors, such as ethnicity and education, is particularly encouraged.

Note: The treatment effect refers to a change in real earnings in dollars for the year 1987 for a group exposed to the job skill training. Mentions in brackets (A1) refer to the calculations found in the appendix. Predictors included in the model are treat, age, educ, black, nodegr, and re75.

Target High School Graduates

Despite limitations of the applied methods that will be discussed later, the data indicates a higher treatment effect, and thus success rate, for subjects with high school degrees than for subjects without.

A comparison of estimated treatment effects based on *multivariate regression* showed a positive treatment effect of 1154 for those without a high school degree, and a positive treatment effect of 3192 for those with a high school degree, a difference of 2038. (A4)

Estimating the counterfactual potential outcomes via *random forest* calculations showed similar results, but on a much smaller scale, as the average treatment effect for graduates (858) exceeds the effect for non-graduates (208) by 650. However, major limitations to this analysis restrict its usage, see below. (B3)

While the quality of the effect estimate is unclear, the *Fisher's exact test* assures that there *is* an effect. The sharp null hypothesis of no treatment was successfully rejected by a p-value of 0.0022 for the observed treatment effect of 1794. (C6) Image 1 visualizes the Fisher interval in red, as well as the outer lying observed treatment effect in green.

Though differing in size, both methods suggest a more successful implementation among high school graduates. Targeting high school graduates thus can bring more efficient outcomes.

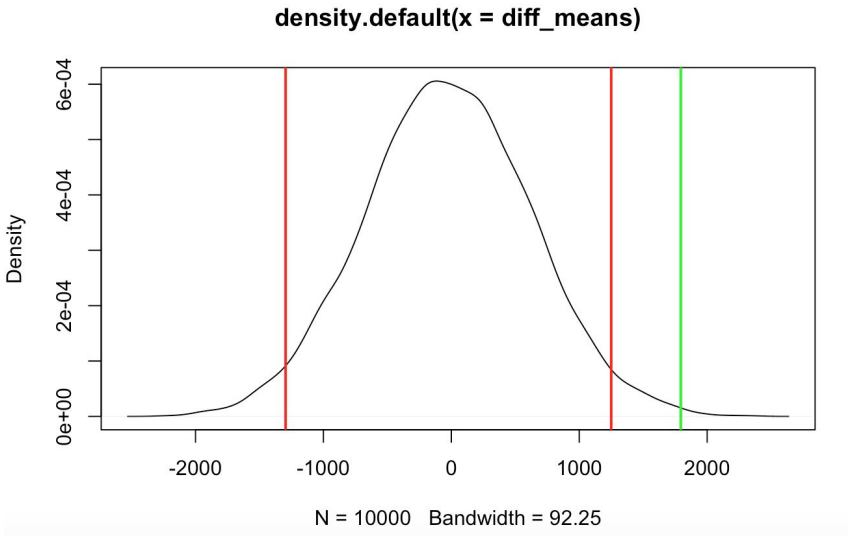

Image 1 - Density Plot, Lower Bound (red), Upper Bound (red), Observed Effect (green)

Revisit Training Performance

The poor performance indicators of the model suggest, however, that the predictions are not strong enough to hold.

The *multivariate regression* has an adjusted R-squared value of 0.039, indicating that not even 0.5% of the variance can be explained via the model. While the F-Statistic (4>1) and p-value (0.00<0.05) suggest that there indeed is a significant effect, the model is not strong enough to show the correct coefficients. (A1)

```
> summary(reg.use)

Call:
lm(formula = re78 ~ treat + age + educ + black + nodegr + re75,
    data = lalonde)

Residuals:
   Min     1Q Median     3Q    Max
 -9301  -4450  -1659   3038  54041

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  1.294e+03  3.176e+03   0.407  0.68397
treat        1.630e+03  6.341e+02   2.570  0.01049 *
age          5.047e+01  4.414e+01   1.143  0.25348
educ         3.764e+02  2.251e+02   1.672  0.09520 .
black       -2.180e+03  8.384e+02  -2.600  0.00963 **
nodegr      -2.128e+02  9.912e+02  -0.215  0.83010
re75         1.420e-01  9.855e-02   1.440  0.15045
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 6500 on 438 degrees of freedom
Multiple R-squared:  0.0523,    Adjusted R-squared:  0.03931
F-statistic: 4.028 on 6 and 438 DF,  p-value: 0.0006098
```

Image 2 - Multivariate Regression

The percentage variance explained in the *random forest* models are for both graduated and non-graduated subgroups negative, indicating that the model in fact performs worse than randomly guessing. Even as importance is set to TRUE, to give important factors more weight, the model does not improve, invalidating the claim above that high school graduates had greater success. (B1)

The *Fisher's Exact Test* is not ideally applied as it is created for small sample sizes, and not 445 such as in this case. To avoid stretching computing power, a random subset of combinations was assessed. This, however, results in the test not fulfilling its "exact" p-value calculation anymore. (C5)

Before taking actions with regards to implementations of the job skill training, a more thorough analysis of the training performance has to be undertaken.

Diversify Focus of Predictors, Change Methods

What is certain is that there is a treatment effect, however it remains to solve where the effect comes from. The data showed highly correlated factors, such as both being black and having no high school degree. This not only decreases the quality of the linear regression model applied here, which assumes additivity, but also suggests to look into intersectional predictors more thoroughly. For example, the positive interaction term treat:nodegr indicates that individuals who are both "black" and receive "treat" benefit from treatment more than those who receive "treat" but are not "black". Different individuals have different treatment effects. While the *random forest* method attempts to decorrelate the predictors, its performance is not good enough to be reliable. Other non-linear methods must be consulted.

Factors that show particularly important are "black", "educ", "nodegr" and "treat". As seen in Image 2, the *multivariate regression* model assigns "black", "treat" and "educ" statistical significance in decreasing order. The *random forest* model assigns importances to "black", "nodegr", and "educ", in decreasing order, as they would most highly result in an increase of mean squared error (MSE) if changed randomly. As "black" stands out in both, it is worth considering an evaluation of the program on this subgroup of the population.

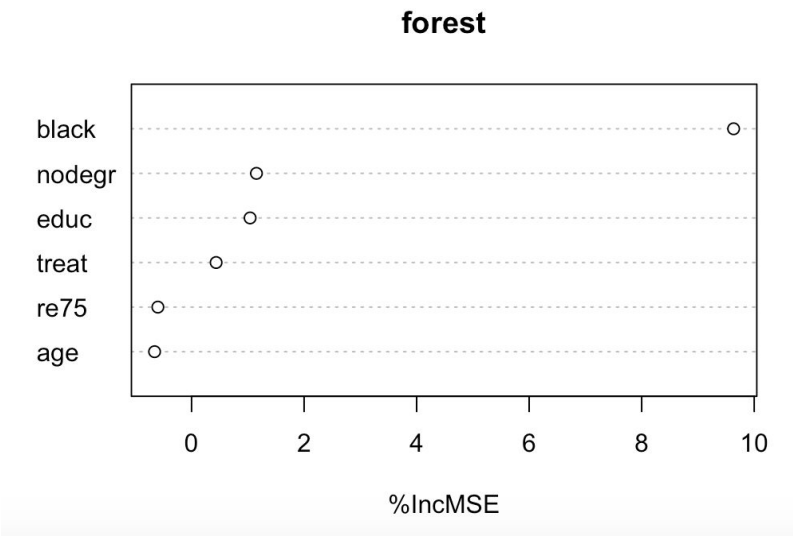

Image 3 - Importance Measure for Predictors (both subgroups)

Conclusion

Some evidence (multivariate regression, random forest) suggest a focus on individuals with high school degree respond more positively to the training than those without. The confidence in the models is not strong enough to assure this effect for future implementations. Provided resources are available, a revision of the assessment is advised. Otherwise, a focus on individuals with high school degree is suggested.

Appendix

R-Code

https://gist.github.com/anonymous/c0dc0bc89aafb9eccbc8755fb3cdaa11